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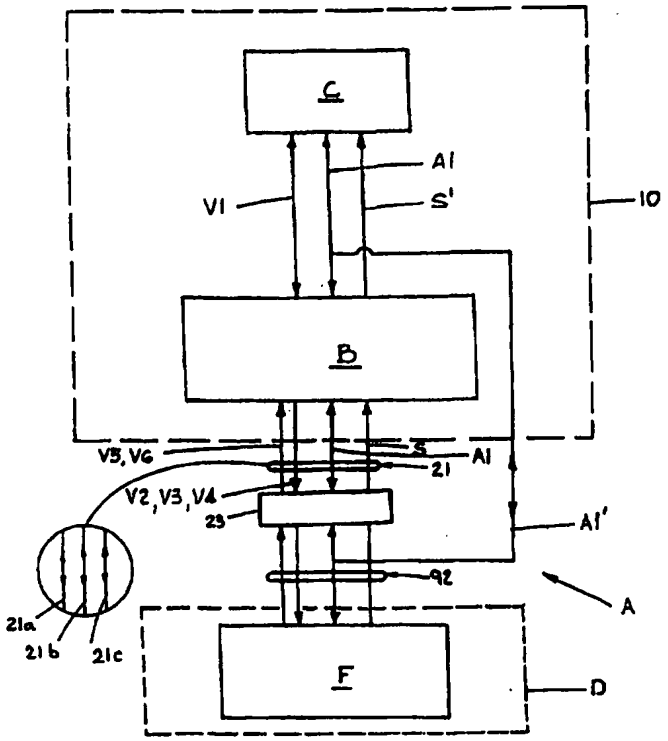
(54) Title: VIDEO SERVICE SYSTEM AND METHOD

(57) Abstract

A method and system for servicing machinery within a plant (10) from a geographically remote service center (D). Trained service personnel are located at the service center and monitor the operating machinery at the plant by a portable video camera. Audio communication between service center personnel and plant personnel is provided so that the plant personnel can be directed in the service and maintenance operations. The plant may be divided into a plurality of zones with each zone having an antenna for transmitting to the base service center (B). Switching from one zone antenna to another is provided so that maximum strength of video signal is achieved.



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VIDEO SERVICE SYSTEM AND METHOD

Background of the Invention

This invention relates to a system and method for servicing machinery in operation within an industrial plant by service personnel at a geographically remote service center.

Previously, it has been known to monitor the production of machinery and processes, and communicate production and other data to a remote facility. For example, United States Patent No. 5,309,351 discloses a system for transmitting maintenance and diagnostic information over a communication satellite between a computer or hand held unit, and factory machinery.

It is also known to use video cameras to observe events from a remote location. For example, U. S. Patent No. 5,382,943 discloses a security system which uses a video camera for monitoring the security of a remote building site from a central control center via radio transmission. U. S. Patent No. 5,384,588, discloses wire and wireless transmission of video signals, such as in a video conferencing system, wherein the video signal may be split up into different components for viewing different sites. U.S. Patent No. 4,789,947 discloses a video camera mounted on a guide rack for monitoring the condition of a bridge from a remote location. U. S. Patent Nos. 4,656,509 and 5,241,380 disclose track mounted video cameras for monitoring a condition from a remote location.

U. S. Patent No. 5,350,033 discloses a robotic inspection vehicle and video camera operated by a joystick at a remote location using radio transceiver devices.

However, none of the above systems and methods are entirely suitable for servicing machinery in operation at an industrial plant from a remote service center, particularly where the machinery is dispersed at several locations in the plant, and allow audio and video communication between plant and service personnel.

Accordingly, an object of the present invention is to provide a system and method for the servicing of machinery operating in a plant from a geographically remote service center;

Another object of the present invention is to provide a system and method for the remote servicing of machinery operating at a plant facility whereby the operation of the machinery may be viewed at a geographically remote service center at which trained service personnel may communicate with plant personnel to service the machinery without the need of costly travel;

Another object of the present invention is to provide a remote servicing system by which operating machinery at a plant may be serviced at a remote service center by trained service personnel wherein video monitoring may be controlled remotely by the service personnel to allow video focusing on a desired area of the operating machinery for servicing;

Another object of the present invention is to provide a system and method for the remote servicing of machinery operating in a plant by experienced service personnel at a geographically remote location wherein machinery operating at various dispersed locations within a plant facility, or multiple plants, may be viewed using the system and method;

Another object of the present invention is to provide a system and method for the servicing of machinery operating in a plant by trained service personnel at a geographically remote location wherein both video and audio monitoring of the machinery may be provided at different machinery locations between service and plant personnel to eliminate the need of costly travel for the servicing of the machinery.

Summary of the Invention

In accordance with the method of the invention, the method includes servicing machinery at a plant from a geographically remote service center employing trained service personnel by monitoring operating machinery at the plant with a video camera and transmitting a video signal to a base unit associated with the plant. The signal is processed at the base unit for transmission over a telecommunication system to the remote service center. The video signal is then displayed on a monitor at the remote service center, and audio communication is provided between plant personnel and the service personnel at the remote service center. Preferably, the operating machinery is monitored in the plant with a portable video

camera by moving the portable video camera to a desired area of the operating machinery which needs servicing. This is accomplished by mounting the portable video camera on a transportable carrier, and moving and focusing the camera on the operating machinery for servicing by using a remote controller. The remote controller may be provided at the geographically remote service center so that the service personnel may focus on an area of the operating machine needing service, at the base unit, and/or the portable unit. In accordance with other aspects of the method, the plant may be divided into a plurality of machinery zones having a zone antenna. The video signal is transmitted from one of the antennas to the base unit that provides a video signal of maximum strength and includes switching between the antennas and base unit depending upon the strength of the video signal at the antennas to provide reception of the video signal of maximum strength at the base unit.

Description of the Drawings

The construction designed to carry out the invention will hereinafter be described, together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

Figure 1 is a simplified block diagram of a basic system and method for the servicing of in-plant machinery from a geographically remote service center according to the invention;

Figure 2 is a detailed schematic and block diagram of a system and method for servicing in-plant machinery by trained service personnel at a geographically remote service center according to the invention wherein machines are located at different zones in a plant facility;

Figure 3 is a detailed schematic and block diagram of a system and method for the servicing of in-plant machinery from a geographically remote service center where the machinery is located at different plant locations and/or zones according to the invention; and

Figure 4 is a schematic diagram of a remote service center from which machinery operating at a geographically remote plant facility may be serviced according to the system and method of the present invention.

Description of a Preferred Embodiment

Referring now to the drawings, the invention will now be described in more detail. As can best been seen in Figures 1 and 2, a preferred embodiment of a video service system, designated generally as A, is illustrated for servicing machinery from a geographically remote location in accordance with the invention. Video service system A includes a base

unit B located within a plant 10 in which the machinery to be serviced is located. There is a portable video unit C for monitoring the operating machinery having a video camera 11 with a video output which provides a first video signal V1 of the operating machinery which is transmitted to base unit B. The video signal is encoded for security and transmitted over telephone lines as encrypted video signal V2 to a remote service center D where trained service personnel study a video display of the operating machinery and communicate orally with plant personnel attending the machinery.

As can best be seen in Figure 2, portable unit C is located in plant 10 which may be a typical manufacturing plant facility having machinery and processes that must be serviced on a routine basis. The portable unit may be located in any one of a plurality of zones "Z" within the plant. Portable unit C transmits first video signal V1 from the plant, preferably using any one of a plurality of zone antennas, designated generally as 12, to plant base unit B located in a plant control room 14. As illustrated, zone antennas 12a-12d are located in zones Z1-Z4 to provide transmission of a high quality video signal to the base unit as portable video unit C is moved within the plant. Zone lines 15 may divide the plant into individual zones Z to provide the best video signal transmission quality to the base unit from a particular area of the plant. Physical barriers and electrical interference signals

may determine the shape and size of the individual zones within plant 10.

In addition, one or more stationary video cameras 11a may be utilized in lieu of or in addition to portable camera 11 to provide video coverage for the machinery or process in each plant or zone. The stationary video cameras may be affixed to ceilings, walls, or stands as needed to adequately cover the operating machinery. Stationary cameras 11a may be hard wired to base unit B for transmission of video signals and camera position control signals from a remote controller.

In accordance with another aspect of the invention, as can best be seen in Figure 3, multiple plant locations each having a plurality of zones may be serviced according to the invention. For example, there may be three plants 16, 18, and 20. Each plant may have any number of zones, or only a single zone, as illustrated at plant 20. Each plant preferably has at least one portable unit C to generate a video signal of the plant's machinery which is transmitted to a base unit B at each plant. For example portable units and base units C1 and B1, C2 and B2, and C3 and B3 may be employed at plants 16, 18, and 20, respectively.

As in the case of either the embodiment of Figures 2 or 3, the plant base units generate second video signal V2 to be transmitted by a telecommunications system such as a telephone system which includes phone line(s) 21. A communication interface 21a receives the signals and transmits the video

signals, we well as other signals to be described, to remote service center D. The communication interface may be that a phone company, cellular system, and/or satellite system, and the like. The use of public systems or lines may require that video signal V1 be encrypted for security of the information being transmitted. First video signal V1 is received by base unit B, and encrypted by an encoding/decoding device E to generate an encoded second video signal V2 transmission over the phone line(s) 21 to service center D.

As can best be seen in Figure 4, second video signal V2 is received by a center base unit F at remote service center D. Center base unit F may be essentially the same type unit as base unit B associated with the plant(s). Center base unit F includes an decoder G for decoding the encrypted signal V2 to produce a video display. Second video signal V2 can be selectively received over telephone line(s) 21 from any plant 16-20 for evaluation, and for responding to the needs of the plant. Focusing of camera 11 of portable unit C upon the machinery may be controlled at portable unit C, from the plant base unit B, and/or service center base unit E by using a control signal S transmitted to portable camera 11. Audio signal A1 is transmitted between the plant base unit B and the service center base unit F. Service assistance is provided for the machinery within a selected plant by trained service personnel based at remote service center D based on audio signal A1 and video signal V2 received at the service center.

Audio signal A1 may be transmitted between base unit B and base unit F, or pass directly to service center base unit F as audio signal A1 (Figure 1), or be transmitted over separate telephone sets and lines.

Details of the system and method components within a respective plant can best be seen in Figure 2. Portable unit C has wheels 32 for manual transportation of portable unit C to various zones where the operating machinery is located in plant 10. The portable unit may include a battery pack 34 which can be periodically charged using a battery charger unit 36 to make the portable unit independent of a power supply from the plant, and more portable. Portable video camera 11 is included in the portable unit to provide video signals of operating machinery 38 to be serviced. Video signals from the portable video camera 11 are referred to in this discussion as first video signal V1. The portable unit has a video antenna 40 for transmitting the first video signal to a zone antenna 12. Portable video camera 11, or optional stationary video camera 11a, can be rotated and focused by control signals S coming from a remote controller to focus on a portion of the machinery necessary for servicing. The camera control signals S may come from a controller at the portable unit, a remote controller 68 at base unit B, or from a remote controller 93 at service center D. In addition, camera 11 may be moved and focused manually by an attendant at portable unit C. In an advantageous aspect of the invention, camera focusing can be

done by trained service personnel at remote service center D who know exactly what area of the machine to focus on in order to service or repair the problem. Camera control signals S may be transmitted from zone antenna 12 to the camera 11 at the portable unit using hard wiring 43 connected between a zone antenna plug and camera 11. Alternately, radio transmitters may be used to transmit control signals S, between a zone antenna 12 and camera 11. A manual control cable 44 may be connected to the portable unit C to provide control of the portable camera 11 by an attendant. Preferably, RF transmitter may also be used to transmit video signal V1 from portable camera 11 to a zone antenna 12.

Transmissions of video and control signals between portable unit C and base unit B in plant control room 14 may be made using a central exchange 42. The central exchange may control signals from zone antennas 12a-12d (Figure 2). The zone antennas 12a-12d communicate with the video camera antenna 40 on portable camera 11. There is a zone unit in each area of the plant as required to provide quality reception of the first video signal necessary for servicing of plant machinery 38, and the control signals.

Audio signals A1 may be transmitted through the zone antennas and base unit(s), as described below. Preferably, transmission of the first video signal from portable unit C to zone unit antennas 12a-12b is realized by utilizing radio frequency (RF) transmitters and receivers. For this purpose,

an automatic switch 46, such as a conventional rotary switching unit, may be included in central exchange 42 to automatically connect base unit B to the antenna providing the strongest video signal. If switch 46 is a manual switch, it may be located at the base unit. Each zone antenna 12 may be connected by a hardwired zone line 48 to central exchange 42 and to base unit B in plant control room 14 for further transmission of the first video signals. In other embodiments of the invention, base unit B may be located at operating machinery 38 so that a base unit video camera 13 may also be used for surveillance of the machinery while portable video unit C moves around the machinery.

As mentioned previously, video signals V1 transmitted by the zone lines 48 to base unit B exit the base unit by way of encoder/decoder device E which digitizes the video signals for transmission of secured video signals over the phone line 21. Communication interface 21a transmits second video signal V2 to the service center D, as well as remote control signals S for camera 11, or stationary cameras 11a, coming from service center D.

Plant base unit B includes a number of basic components within the base unit as well as a number of peripheral components. The base unit includes video and audio electrical components, and computer equipment having a video monitor 54 with split screen viewing capabilities. The video/audio components use video response system (VRS) technology well

known in the industry. These base unit components and equipment are known in the industry to provide picture tube viewing of the video signal from a camera in a conventional manner. Base unit camera 13 may be used to provide a video signal of a control room subject 56, such as plant personnel in conference with service personnel at remote service center D. The base unit camera can also be controlled for panning and zooming on the control room subject. Base unit video signal V3 can be viewed on a monitor at the service center. In an advantageous aspect of the invention, a zoom unit 60 having a zoom camera 62 may be provided for detailed viewing of a subject such as a machine part. The zoom camera can provide a zoom video signal V4 of a zoom subject 64 for possible viewing on the monitor. The zoom subject can be a component part from plant machinery 38, a process control chart, a circuit board or any similar servicing aid or prop, and the like. Base video camera 13 and zoom camera 62 may be hard wired to the base unit monitor, or wireless communication may be had.

If the switch at central exchange 42, base unit B is to be a manual switch, it may be located as rotary switch 66 at the base unit B. The rotary switch may be manually switched to receive signals from each zone unit such that an operator can select the best zone unit for a clear picture on the monitor. Preferably, the rotary switch is made to automatically scan the zone units at exchange 42, and select the best unit for transmission of clear video signals from portable unit C.

As mentioned previously, remote controller 68 is provided at base unit B to generate control signals S for controlling portable camera 11 to focus upon the machinery viewed on split screen monitor 54. The remote controller may also control base unit camera 13, and zoom camera 62, in the control room and/or plant. An antenna 70a on base unit B provides a communication link for control signals S coming from remote controller 68. An antenna 70b is provided to receive audio signal A1 directly from an attendant at portable unit C having an audio headset 74. Audio signal A1 is then transmitted through the base unit over line(s) 21 to remote service center D. Audio signal A1 is usually not encoded, but may be. A speaker 72 carried by the base unit may communicate the audio signal and communication to anyone at the base unit and/or within the control room. In addition, audio communication may be had between attendant headset 74 at portable unit C and personnel at base unit B and/or control room 14 provided with an audio headset 76. The headsets may be any standard battery operated audio communication devices used in the industry. The portable unit attendant can be instructed to perform service on the plant machinery or process from the plant control room, and/or from service personnel at remote service center D. Communi-cation of audio messages can also be provided by standard phone sets and telephone lines between any two locations in the network of the video service system.

Referring now to Figure 4, the basic components of the video service system located at the service center D will now be described in detail. Service center D includes a base unit G having components which are essentially the same as those associated with base unit B plant control room 10. Components of the service center base unit G include a center monitor 80, a center speaker and microphone 82, a center video camera 84, a center zoom camera unit 86, and a center remote control unit 88. Center base unit G receives second video signal V2 via an encoder/decoder device 90 which decodes the encrypted video signal V2 to generate a decoded video signal, corresponding to first video signal V1, for display on monitor 80.

Service center camera 84 can scan and focus within the immediate area adjacent base unit G for providing a video signal V4 of a service center subject 96. These video signals along with center audio signals A1 are transmitted to a plant base unit and/or control room for full two-way teleconferencing capability between the plant personnel and service center personnel. The selected base unit and/or control room can be at any plant connected by communication interface 21a of video service system A. There is a zoom unit 86 having a zoom camera 94 which can observe subject 96 at close range and generate video signal V5 for transmission to plant 10. For example, zoom subject 96 may be a diagram, a component machine part, or a circuit board, etc. In addition, a center control switch 98 can transmit switch signals to exchange switch 42 or base unit

rotary switch 66 to select a zone antenna 12 (one of 12a-12d) at the plant (Figure 2) from which the video signal is transmitted to the service center.

The pictures observed on the split screen of monitors 54 and 80 can be selected from any two of the available subjects observed by the various cameras 11, 11a, 13, 62, 84, and 94 in the video service system. The pictures being observed on plant monitor 54 may be controlled by either plant remote controller 68 or the center remote controller 93. The pictures observed by center monitor 80 are controlled by center remote control 93. Control signals from center remote control 93 are received by center receiving antenna 100, and transmitted to base unit B and then through antenna 70b to portable camera 11 or stationery camera 11a. Service center remote controller 93 can control any of the components within the video service system.

Another embodiment of the invention is to transmit first video signal V1 directly from portable unit C to plant base unit B. Direct RF transmissions from portable unit C to base unit B are possible with a single zone unit Z located near base unit B as in the case of plant facility 20 (Figure 3) . This embodiment is useful in plants where video signals are not obstructed and in plants of a small size. A further embodiment may be realized by locating base unit B in a plant area adjacent portable unit C. Video signals from portable camera 11 to base unit B, and camera control signals S, can both be hard

wired. For example, this embodiment is useful in plants where adequate floor space exists in the area of the plant machinery for the base unit and for installations where the need for moving the portable unit C is limited.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. A method for servicing machinery at a plant from a geographically remote service center employing trained service personnel comprising:

monitoring operating machinery at said plant with a video camera having a video signal;

transmitting said video signal to a base unit associated with said plant;

processing said video signal at said base unit for transmission over a telecommunication system;

transmitting said video signal from said base unit to said remote service center;

displaying said video signal on a monitor at said remote service center;

providing audio communication between plant personnel at said plant and said service personnel at said remote service center; and

providing service assistance by said service personnel to said plant personnel for said operating machinery while viewing said monitor and listening to said audio communication.

2. The method of claim 1 including monitoring said operating machinery in the plant with a portable video camera which provides a first video signal, and moving said portable video camera to a desired area of said operating machinery which needs servicing.

3. The method of claim 2 including mounting said portable video camera on a transportable carrier, and moving and focusing said camera on said operating machinery for servicing by using a remote controller.

4. The method of claim 3 including controlling the focusing of said portable video camera using a remote controller at said geographically remote service center so that said service personnel may focus upon an area of said operating machine necessary for servicing.

5. The method of claim 1 including providing a plurality of machinery zones within said plant, providing a zone antenna within each of said servicing zones, and transmitting said video signal from one of said antennas to said base unit as that video signal of maximum strength is received from one of said antennas.

6. The method of claim 5 including switching between said antennas and base unit depending upon the strength of said video signal at said antennas to provide reception of said video signal of maximum strength at said base unit.

7. The method of claim 6 including using an automatic switch which automatically senses the strongest signal at one of said antennas and transmits said video signal of maximum strength from said antenna to said base unit.

8. The method of claim 5 including transmitting said video signal from said portable video camera to said antennas using RF transmission.

9. The method of claim 8 including hard wiring said antennas to said base unit.

10. The method of claim 1 including displaying said video signal on a monitor at said base unit in said plant.

11. The method of claim 10 including providing a base unit video camera at said base unit for providing a base video signal which may be transmitted over said telecommunication system to said remote service center.

12. The method of claim 1 including providing a zoom unit at said plant having a zoom video camera for zooming in on details of machine parts and components for providing a zoom video signal of said details for transmission to said remote service center.

13. The method of claim 12 including processing said video signal by encrypting said video signal to provide security for transmission of said video signal to said remote service system.

14. The method of claim 1 including processing said video signal by encrypting said video signal to provide security for transmission of said first video signal to said remote service system.

15. A system for servicing machinery in a plant from a geographically remote service center employing trained service personnel comprising:

a video unit having a video camera for monitoring the operation of said machinery in said plant;

a video camera included in said video unit having a video output which provides a video signal depicting at least a portion of said operating machinery;

a base unit in said plant for receiving said video signal;

a processor included in said base unit for receiving and processing said video signal for transmission over an outside telecommunication system;

an interface connected between said base unit and said telecommunication system for transmitting said video signal over said telephone lines to said remote service center;

a monitor at said remote service center for displaying said video signal; and

an audio communication system for providing audio communication between plant personnel at said plant and said service personnel at said remote service center so that said service personnel may provide technical assistance to said plant personnel in regard to said operating machinery based on said monitor display and audio communication.

16. The apparatus of claim 15 wherein said video unit includes a portable video camera which provides said video signal, and a portable carrier for moving said portable video camera to a desired area of said operating machinery for servicing.

17. The apparatus of claim 16 including a remote camera controller disposed at least at one of said plant and

service center locations for controlling the focusing of said portable camera on said operating machinery.

18. The apparatus of claim 17 wherein said a remote controller is disposed at said geographically remote service center, said remote controller generating camera control signals, said camera control signals being transmitted to said base unit, and a wireless transmitter for transmitting said control signals to said portable camera,so that said service personnel may focus upon an area of said operating machine necessary for servicing.

19. The apparatus of claim 15 including a plurality of machinery servicing zones defined within said plant, and a plurality of zone antennas disposed within said servicing zones, so that said video signal is transmitted from one of said antennas to said base unit depending upon which antenna receives the strongest video signal.

20. The apparatus of claim 19 including a switch connected between said antennas and said base unit for selecting said video signal to provide said strongest signal.

21. The apparatus of claim 20 wherein said switch includes an automatic switching device which automatically senses said strongest video signal at one of said antennas and transmits said strongest video signal from said antenna to said base unit.

22. The apparatus of claim 19 including a radio frequency (RF) transmitter for transmitting said video signal

from said portable video camera to said zone antennas using RF transmission.

23. The apparatus claim 22 including hard wiring connecting said zone antennas to said base units using hard wiring.

24. The apparatus of claim 1 including a base unit monitor for displaying said video signal at said base unit.

25. The apparatus of claim 24 including a base unit video camera at said base unit for providing a base video signal which may be transmitted over said telephone lines to said remote service center.

26. The apparatus of claim 25 wherein said base unit includes an encoder/decoder for encrypting said video signal to provide security for transmission of said video signal to said remote service center.

27. The apparatus of claim 15 including a zoom unit at said plant having a zoom video camera for zooming in on details of machinery parts and components for providing a zoom video signal of said details for transmission to said remote service center.

28. The apparatus of claim 15 wherein said base unit includes an encoder/decoder for encrypting said video signal to provide security for transmission of said video signal to said remote service system.

29. The apparatus of claim 28 wherein said service center includes a decoder for decoding said video signal for display at said service center.

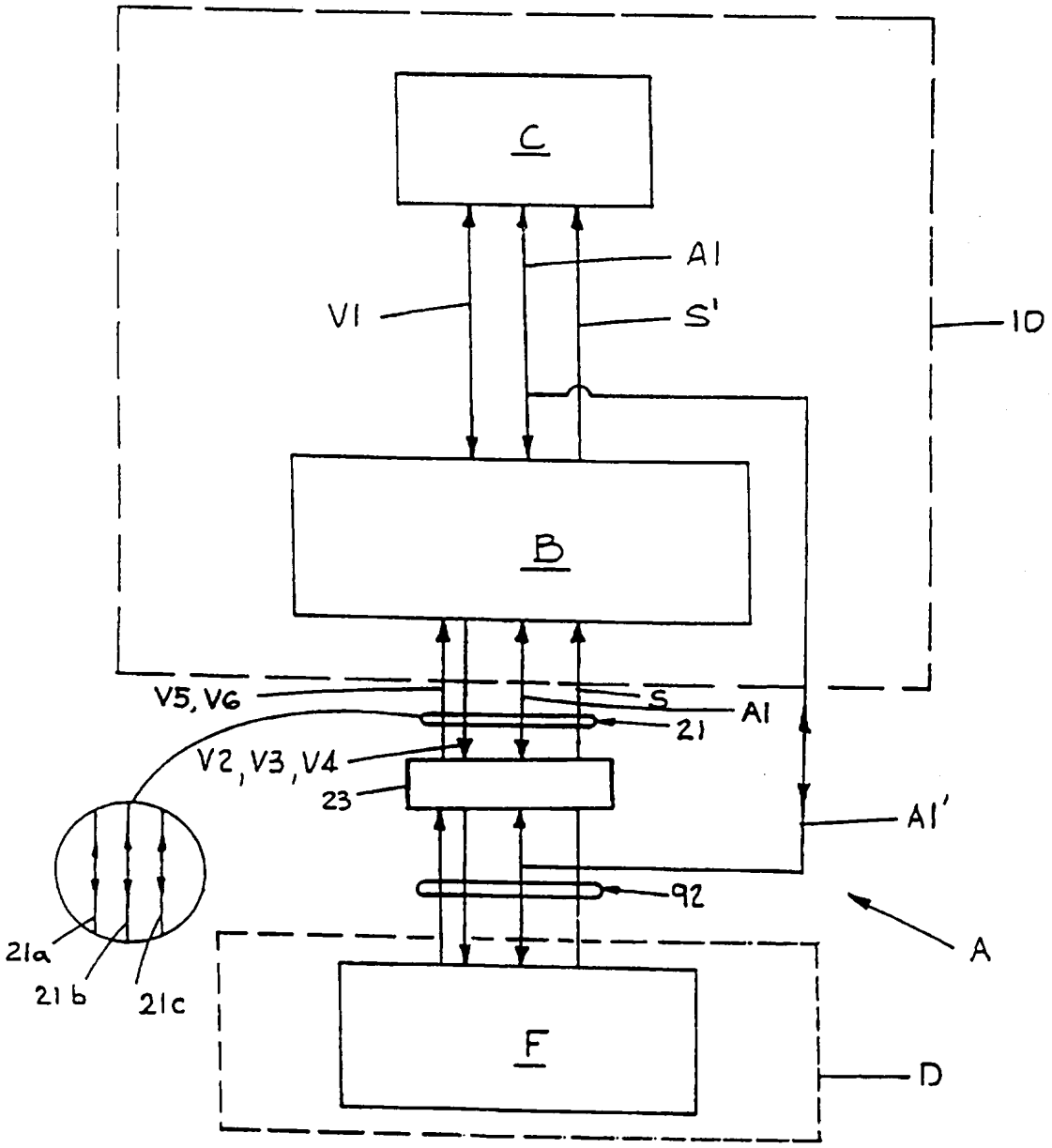
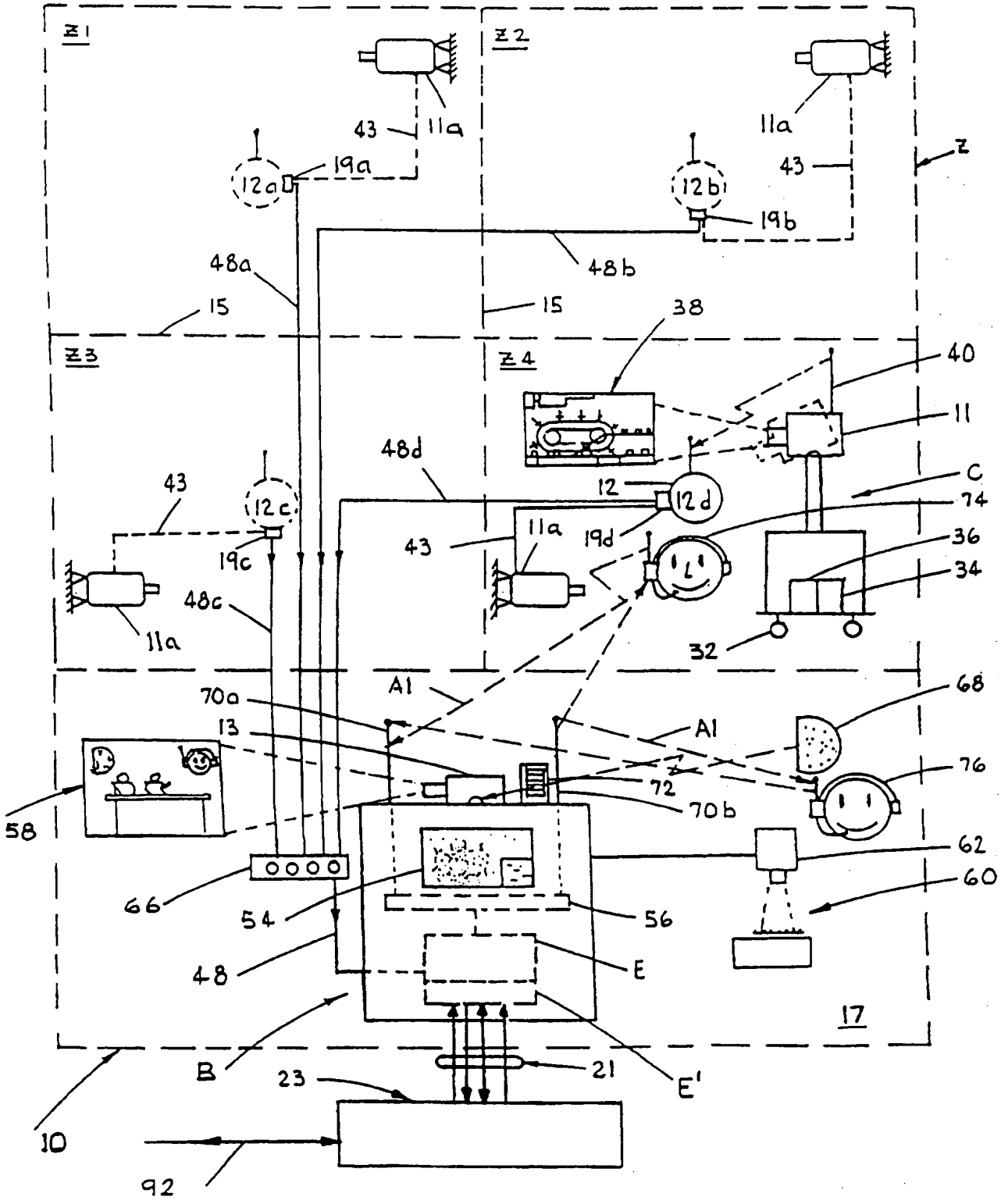


Fig. 1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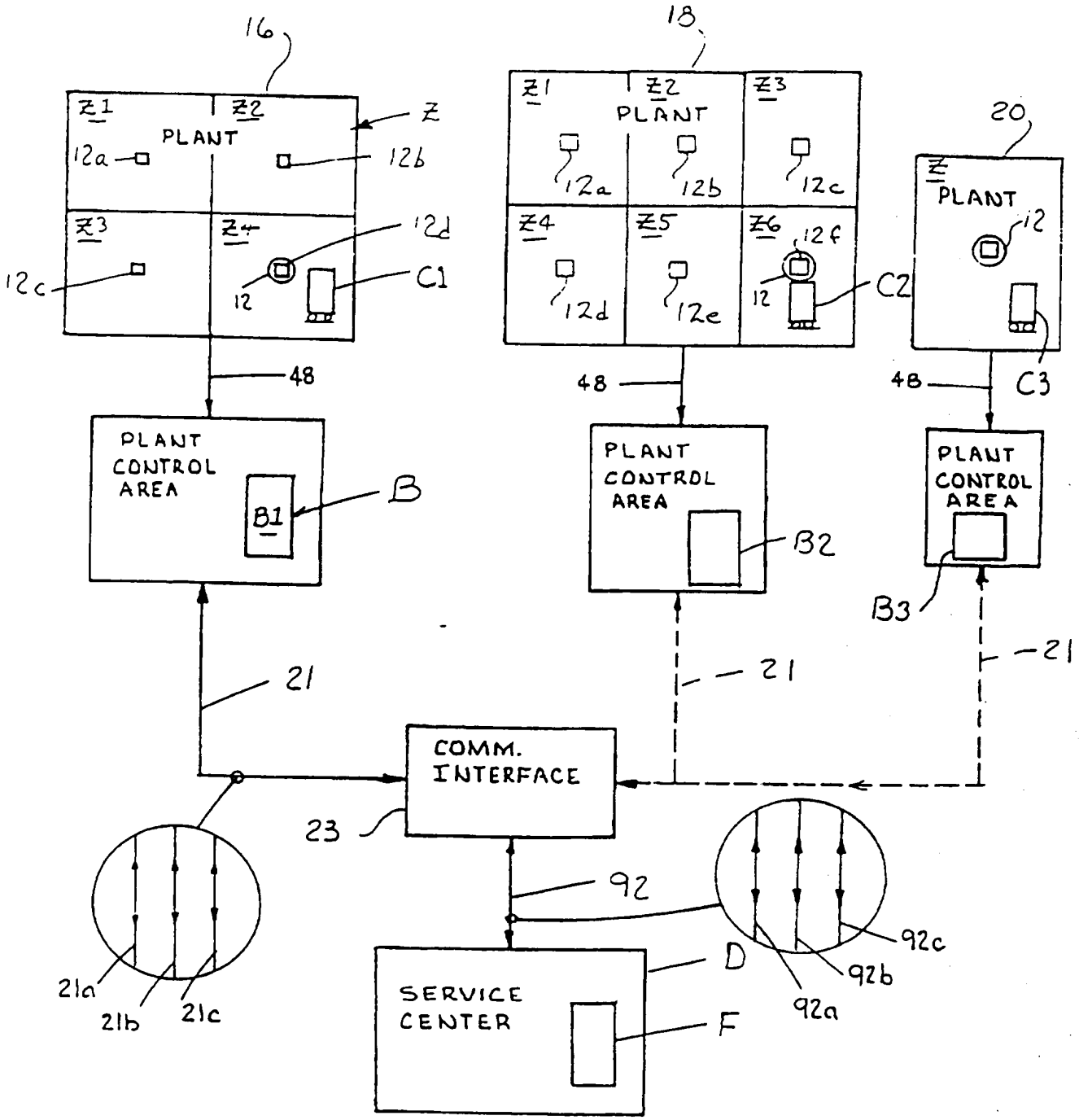
92

Fig. 2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PLANT
Z
12a
12b
Z3
Z4
12d
12c
12
C1
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PLANT CONTROL AREA
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B
21
18
Z1
Z2
PLANT
Z3
12a
12b
12c
Z4
Z5
Z6
12f
12d
12e
12
C2
48
PLANT CONTROL AREA
B2
21
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C3
PLANT CONTROL AREA
B3
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COMM. INTERFACE
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92c
92b
92a
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SERVICE CENTER
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21c

Fig. 3

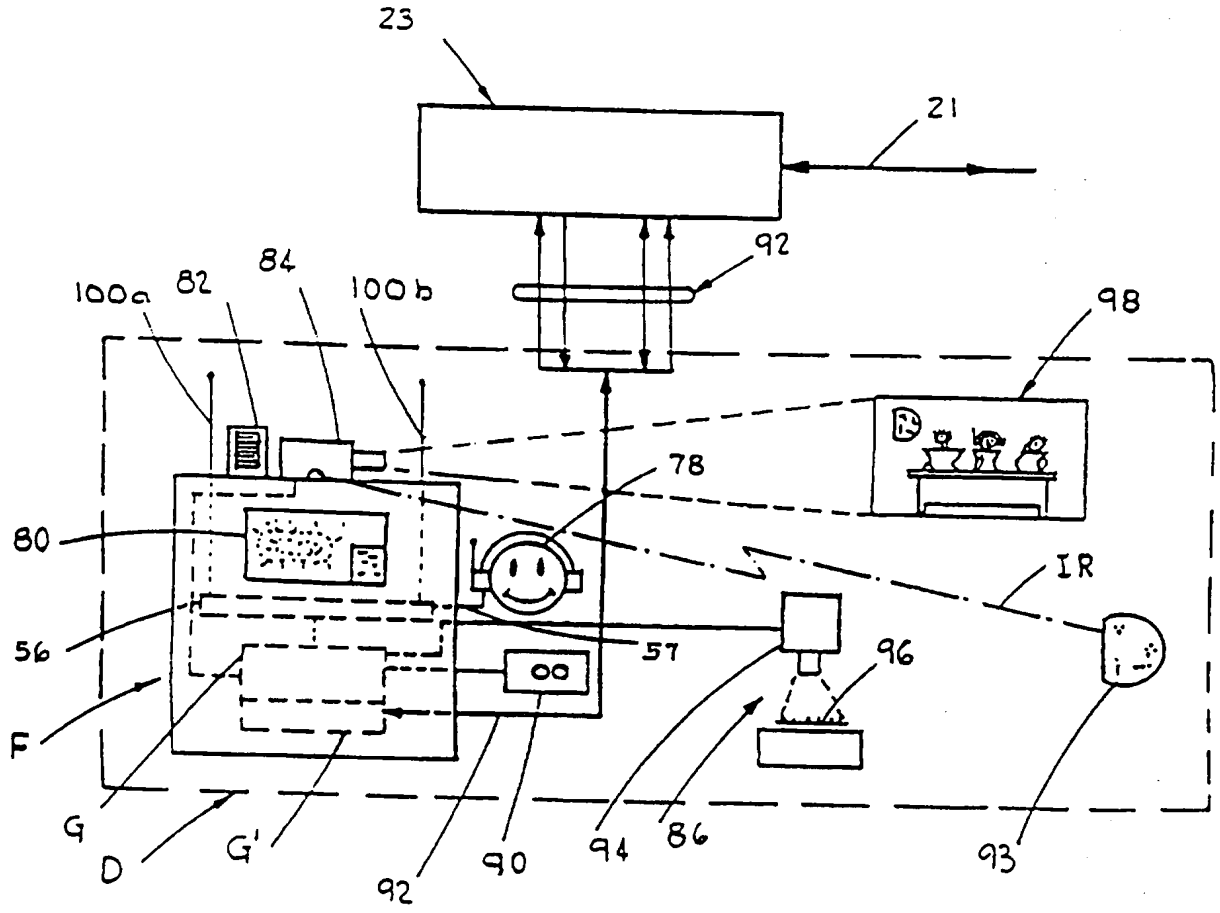

Fig. 4

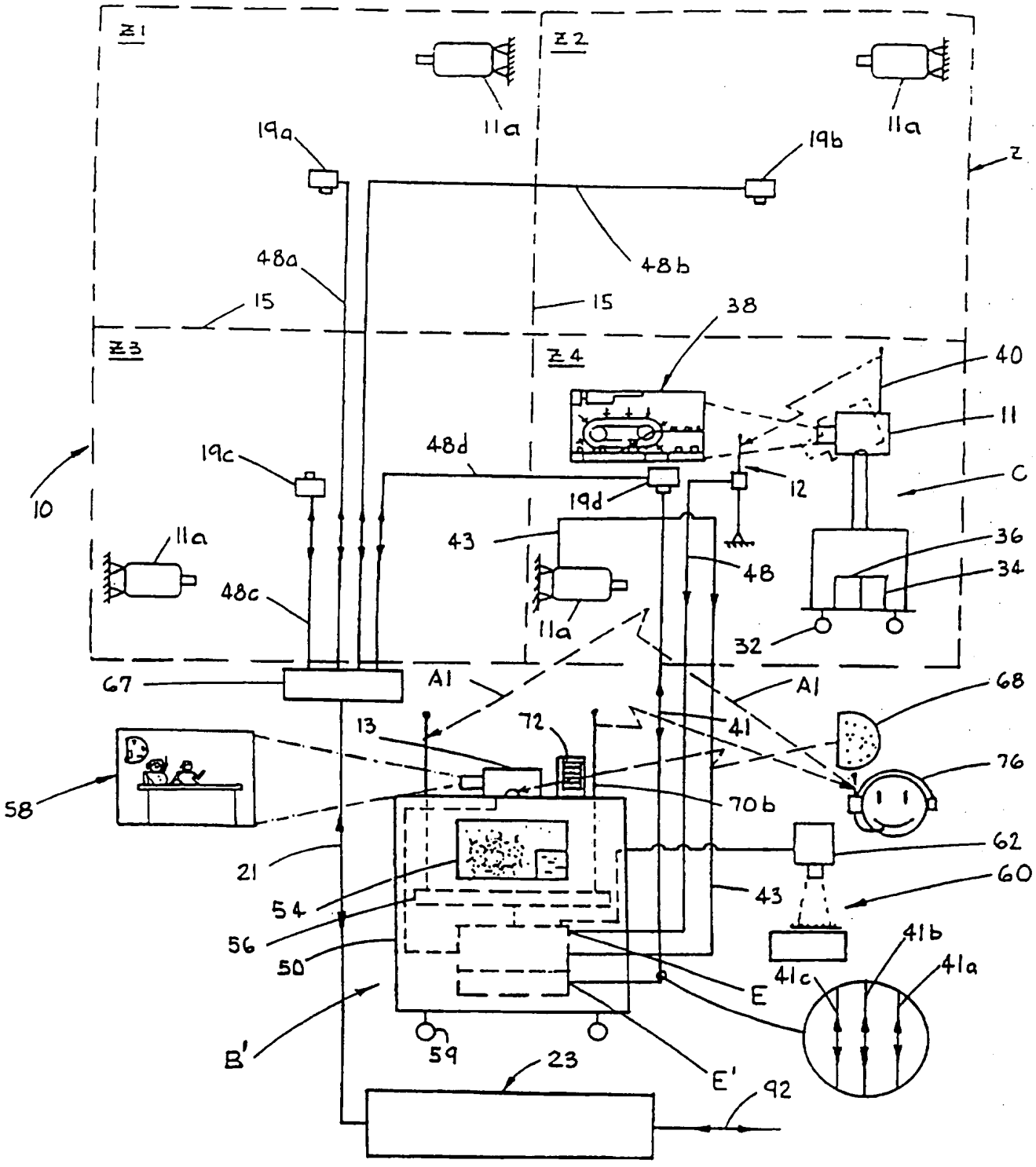
Z1
Z2
Z3
Z4
Z
11a
19a
19b
48a
48b
15
38
40
11
19c
48d
19d
12
C
10
43
48
36
34
48c
32
67
A1
68
13
72
41
76
58
70b
62
21
60
54
56
50
41b
41a
41c
E
B'
59
23
E'
92

Fig. 5

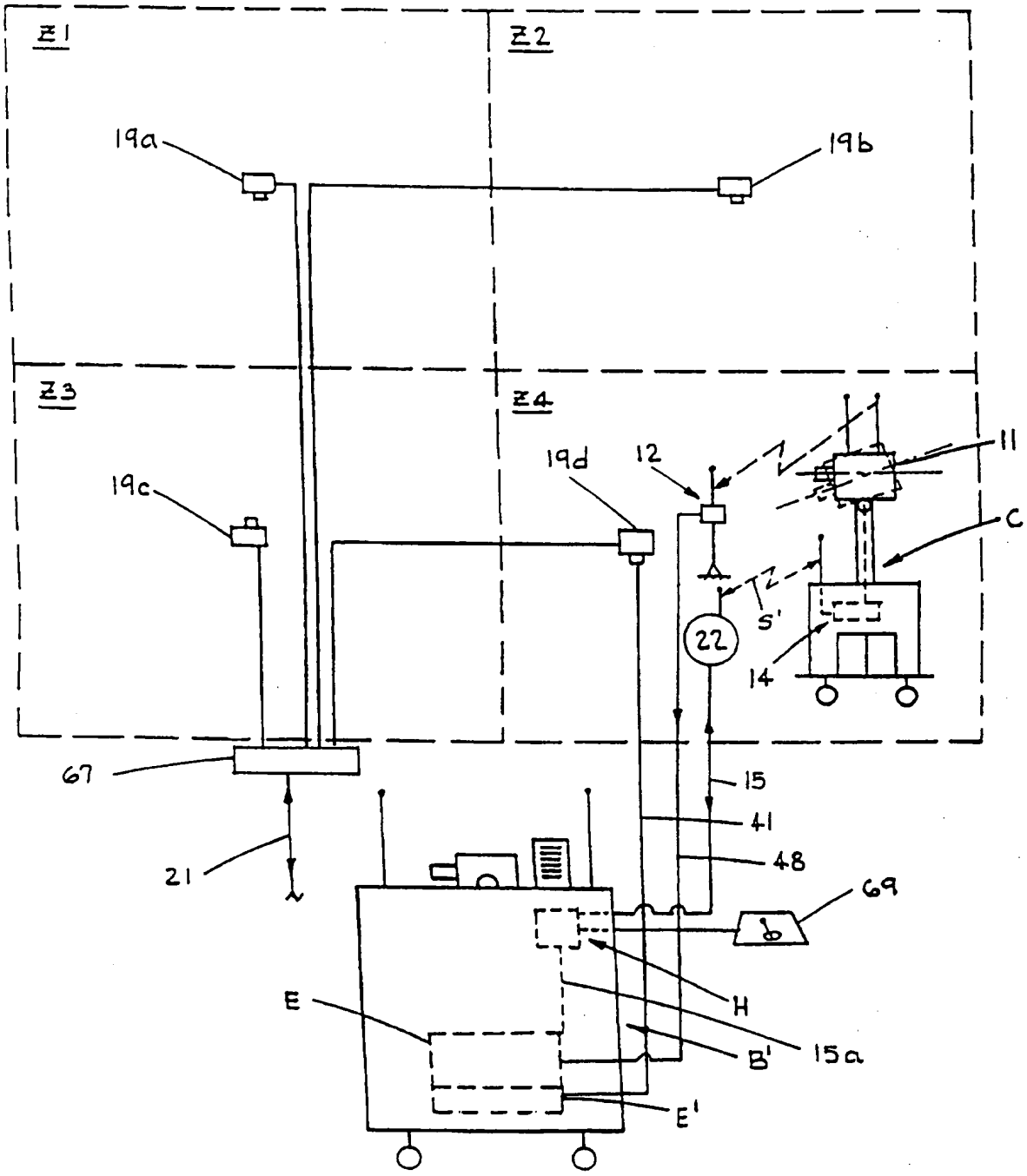

Fig. 6

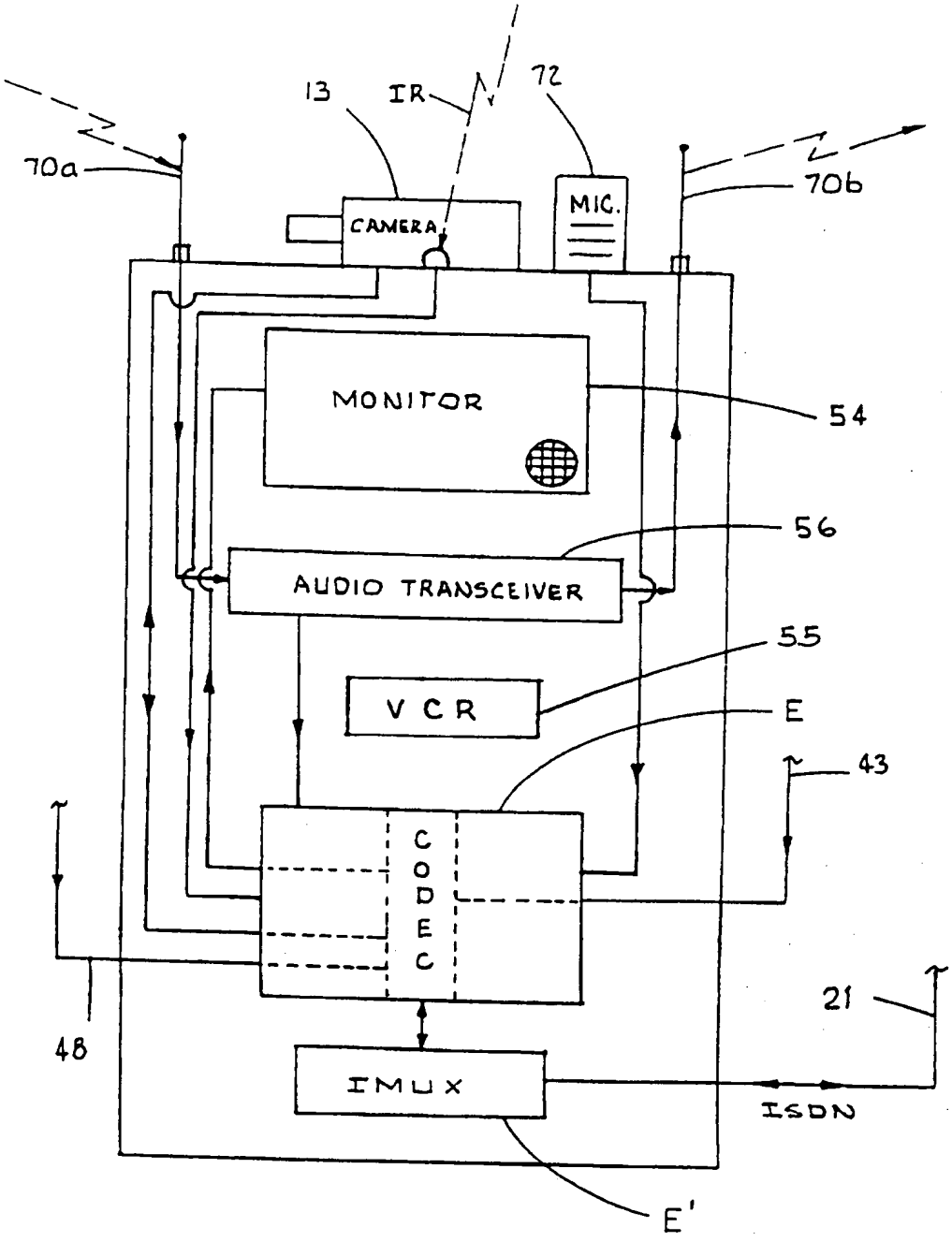
13
IR
72
70a
70b
CAMERA
MIC.
MONITOR
54
56
AUDIO TRANSCEIVER
55
VCR
E
43
CODEC
21
48
IMUX
ISDN
E'

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/04858

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G08B 26/00; H04K 1/02
US CL : 348/143, 153, 159; 455/33.2
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 348/143, 153, 159; 455/33.2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,E	US, 5,619,183 (ZIEGRA et al) 08 April 1997, fig. 5, col. 4, lines 15-57 and col. 5, lines 50-62.	1, 10, 11, 15, 24, 25
Y	US, 4,097,893 (CAMRAS) 27 June 1978, col. 3, 9-38	2, 3, 16, 18
Y	US, 5,241,380 (BENSON et al) 31 August 1993, col. 2, lines 7-19, col. 3, lines 29-63	3, 4, 12, 17, 18, 27, 29
Y	US, 3,155,909 (SHEPHERD) 03 November 1964, figs. 1&4	5-9, 19-23
Y	US, 5,144,661 (SHAMOSH et al) 01 September 1992, col.2, lines 24-26	13, 14, 26, 28

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 19 MAY 1997	Date of mailing of the international search report 24 JUN 1997
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Tommy P. Chin Telephone No. (703) 305-4715

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